TECHNICAL MEMORANDUM

DATE September 10, 2019 **Project No.** 1665649

TO Stephen Keen
CIMA+

CC Chad Davis

FROM Andrew Forbes and Justin Lim **EMAIL Andrew_Forbes@golder.com**
Justin_Lim@golder.com

FLUVIAL GEOMORPHIC ASSESSMENT IN SUPPORT OF THE SCHEDULE C MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT, COLERAINE DRIVE, TOWN OF CALEDON, ONTARIO

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by CIMA+ (CIMA) on behalf of the Regional Municipality of Peel (Peel Region) to complete a fluvial geomorphic assessment in support of the Schedule C Municipal Class Environmental Assessment (EA) for the Coleraine Drive grade separation transit improvement project (the Project) between Holland Drive and Harvest Moon Drive in the Town of Caledon, Ontario (Figure 1). This technical memorandum outlines the methods and results of the fluvial geomorphic assessment in the vicinity of the Project.

1.1 Background

Coleraine Drive between Holland Drive and Harvest Moon Drive currently represents a five-lane arterial road (with middle turning lane) that is oriented generally northwest to southeast. The roadway crosses a Canadian Pacific Railway (CPR) corridor approximately 400 m south of the intersection between Coleraine Drive and Harvest Moon Drive (Figure 1). A grade separation has been proposed at Coleraine Drive and the CPR line as part of Peel Region's 2019 Long Range Transportation Plan (LRTP) to mitigate future traffic congestion and to ease the movement of rail goods.

Residential housing and Stormwater Management (SWM) facilities represent the prominent land use in the area to the north of the intersection of Coleraine Drive and Old Ellwood Drive (located roughly halfway between Holland Drive and Harvest Moon Drive), while industrial and commercial land use is dominant in the area to the south. Of note, Harvest Moon Drive becomes King Street West to the east of the intersection between Coleraine Drive and Harvest Moon Drive.

The proposed roadway improvements include one watercourse crossing that is located 75 metres (m) south of the intersection between Coleraine Drive and Harvest Moon Drive. This watercourse represents a small unnamed tributary of the Main Humber River (1st Order stream) that flows in a generally southwest to northeast direction and includes a catchment area of approximately 1.2 km^2. Streamflow at the unnamed tributary largely reflects outflows from an upstream SWM Pond that is located to the immediate southwest of the intersection of Coleraine Drive and Harvest Moon Drive. Discharge from the SWM pond is directed beneath Coleraine Drive via a circular concrete culvert with a 1.5 m diameter, and, in turn, reports to the channel of the unnamed tributary on the

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eastern side of Coleraine Drive. The flows at the channel eventually drain to a separate SWM Pond at a location approximately 300 m downstream of Coleraine Drive.

1.2 Purpose and Scope

Modifications to the roadway at Coleraine Drive have the potential to influence channel conditions at the unnamed tributary. To that end, a fluvial geomorphic assessment was completed along defined 'reach lengths' (i.e., sections of the watercourse that include similar geomorphic characteristics and controls) to assess meander potential and channel stability. The results of the fluvial geomorphic assessments will be used to support the Class EA process, as well as to assist with the preliminary design of any modifications to the watercourse crossing (e.g., upgrades or replacement of the existing crossing structure associated with the grade separation works).

The specific work scope involved the following tasks:

- Background review and field inspections at all reach lengths to characterize channel morphology and assess bed and bank stability;
- Meander belt width assessment at select reach lengths to determine the meander potential of the stream in the vicinity of the roadway improvements; and,
- 100-year erosion evaluation at select reach lengths to determine the long-term erosion potential of the stream in the vicinity of the roadway improvements.

Each of these tasks is described below in Section 2.0.

2.0 METHODOLOGY

2.1 Background Review and Field Inspections

The following background information was reviewed to assist with the fluvial geomorphic assessment at Coleraine Drive:

- Orthoimagery from 2015 that was retrieved from the Digital Globe spatial data service;
- Aerial photography for 1946, 1951, and 1974 that was obtained from the National Air Photo Library; and,
- 2016 topographic data (5 m contour elevation lines) that was retrieved from The Ministry of Natural Resources' Land Information Ontario database.

In addition to the background review, a site visit was completed on August 10, 2017. The site reconnaissance included a walk-over at all relevant reach lengths to assess channel morphology and to identify any areas of instability. Further to these general inspections, field activities at reach lengths involved substrate sampling and Rapid Geomorphic Assessments (RGAs). The field data was used to inform the meander belt width and 100-year erosion assessments (Sections 2.2 and 2.3).

2.2 Meander Belt Assessment

A meander belt width assessment was conducted at select reach lengths based on protocols developed by Toronto and Region Conservation Authority (TRCA, 2004). The belt width assessment included the following activities:

- Background preparation, comprising a detailed analysis of maps and historical aerial photographs/orthoimagery from 1946, 1951, 1974, and 2015, in order to delineate the reach lengths and examine historical land use and channel patterns;
- Field reconnaissance at the identified reach lengths (described in Section 2.1) to evaluate current conditions and obtain measurements of channel geometry; and,
- Delineation/quantification of meander belt widths at select reach lengths to infer the stream corridor that the channel encompassed in the past and could potentially occupy in the future.

2.3 100-Year Erosion Assessment

A 100-year erosion assessment was conducted at select reach lengths in accordance with procedures outlined by Toronto and Region Conservation Authority (TRCA, 2007). The development of the 100-year erosion limit considered the average rate of channel migration in the vicinity of the existing culvert crossing and was based on similar activities described for the meander belt width assessment (Section 2.2), namely an analysis of historical aerial photographs and a field reconnaissance.

3.0 RESULTS

3.1 Background Review and Field Inspections

To account for changes in fluvial geomorphologic characteristics along a channel, watercourses are typically separated into reaches that display similar physical characteristics and controls on channel morphology. With reference to Figure 1, field observations in combination with a review of available base mapping and air photographs identified one reach length at the unnamed tributary (described herein as UT-01). The delineation of the reach breaks for UT-01 (i.e., upstream and downstream boundaries of the reach length) were based on observed changes in hydrology and hydraulics, recognizing that the upstream reach is located immediately downstream of the upstream SWM Pond (located to the immediate west of Coleraine Drive), while the downstream reach break is located immediately upstream of the downstream SWM Pond.

The key characteristics of the reach length at the unnamed tributary (UT-01) are outlined in Table 1. Photographs of the existing channel conditions are presented in Attachment A.

Table 1: Key Results from Background Review and Field Inspections at Unnamed Tributary (UT-01)

Reach Length	General Description of Channel Morphology and/or Water Feature Conditions	Bankfull Width	Channel Substrate	Riparian Conditions	Additional Remarks from Background Review and Field Reconnaissance
UT-01	- Small intermittent watercourse with well-defined bed and bank that includes: - mostly alluvial controls; - low sinuosity; - limited bed morphology (i.e., channel bed is mostly flat); - notable entrenchment (i.e., channel is well-incised between steeply sloped banks); and, - numerous examples of instream woody debris or overhanging trees. - Erosion and/or depositional features at the channel that include: - instances of sediment deposition features along the bed (e.g., point or side-channel bars on the inside of meander bends, along with medial and lobate bars at some mid-channel locations); and, - numerous instances of bank erosion/scour along the outside of meander bends (apex or full length of the meander bend), extending vertically from the toe to the top of the bank and resulting in steep and overhanging banks with exposed roots and soil. - Flow at watercourse is largely dependent on water level and flow conditions at the upstream SWM Pond (located immediately west of Coleraine Drive).	4.6 to 9.3 m (average bankfull width of 7 m).	- Clayey Silt (D_{50} = 0.02 mm) at the bed and banks of the channel downstream of the crossing location. - Fine to Coarse Gravels (D_{50} = 9.5 mm) at the bed and banks of the channel at the crossing location, noting that angular stone/riprap has been placed at the channel immediately downstream of the existing culvert structure.	Riparian areas include a dense cover of shrubs, grasses, and small and large mature trees.	- The existing crossing structure at Coleraine Drive represents a circular concrete culvert with concrete end section, and energy dissipater (flow blocks). The diameter of the circular culvert is 1.5 m. The invert of the concrete end section on the outlet side of the structure is approximately 0.3 m above the downstream channel bed. - Instream controls include waste materials and other debris. - Recreational use at the riparian zone of the channel is evident, noting that walking trails were observed in the overbank areas.

The completed RGA form for UT-01 is presented in Attachment B. The results of the RGA suggest that the evaluated reach length at the unnamed tributary is in a transitional state with evidence of aggradation, degradation and widening. Grain size results for UT-01 are presented in Attachment C.

3.2 Meander Belt Assessment

3.2.1 Aerial Photography Analysis

A historical air photograph analysis was completed in support of the meander belt assessment, and relied on aerial photography and orthoimagery from 1946, 1951, 1974, and 2015. These images/photos were used to evaluate changes in channel patterns and surrounding land use over time at the unnamed tributary (UT-01). The results of the historical air photograph analysis are illustrated on Figure 2, and described below.

Historical land use in the vicinity of UT-01, as well as in the upstream catchment areas of these watercourses, was predominated by agriculture since at least 1974. Between 1974 and present day, land use transitioned primarily to urban development in the area to the north of the CPR line, and industrial and commercial land use in the area to the south of this railway corridor. The urban development was also accompanied by roadway improvement projects, including the widening of King Street West prior to 1974 and the extension of King Street West (to connect with Harvest Moon Drive at Coleraine Drive) prior to 2015.

Riparian vegetation within the areas of investigation has been historically moderate to high in density, consisting of varying amounts of tree, shrub and grass cover. For certain portions of the air photo record, this vegetation cover limited direct observation of features on the ground. In these instances, the channel alignment at UT-01 was inferred to the extent possible (denoted by a broken line on Figure 2).

Channel patterns at UT-01 have been characterized by low sinuosity for the duration of the air photo record, noting that the channel has included only minor adjustments over time (e.g., lateral or downstream shift/migration of the channel in a few locations). A short section of channel at the downstream end of the reach length appears to have been slightly re-aligned between 1951 and 1974 (i.e., straightened along the adjacent roadway embankment of King Street West). This channel alteration likely coincided with the widening of King Street West during this same time period. The air photo records show that the existing SWM pond to the immediate west of Coleraine Drive was constructed between 1974 and 2015, recognizing that, prior to this, a small pond was present in the same area (naturally formed in a low lying pocket) and appears to have been maintained by agricultural runoff from the surrounding lands.

3.2.2 Belt Width Calculations

The meander belt width estimate at the unnamed tributary (UT-01) is illustrated on Figure 3, recognizing that the assessment assumed no further changes in the hydrologic regime for the long term (i.e., flow duration and frequency). The methodology for the meander belt width estimate relies on interpreting whether hydrologic change would be expected under future conditions, with recognition that the fluvial processes (i.e. characteristic flow patterns, hydrological regime, etc.) are major drivers on channel size and associated meander development. Given that the upstream catchment area has been largely developed since the mid-1970s, any potential changes to the hydrological regime at the channel has likely already been realized. A summary of the meander belt width estimates is provided below.

- A preliminary belt width was measured to be approximately 30 m. The preliminary meander belt width represents the measured width between the outer-most meander bends based on historical imagery from 1946 through 2015.

- The existing meander belt width was estimated to be approximately 37 m. The calculation of the existing belt width combines the preliminary meander belt width with the average bankfull width of the channel (approximately 7 m), as estimated in the field (30 m + 7 m = 37 m).
- The final meander belt was estimated to be approximately 48 m. This final belt width combines the estimated existing meander belt width (37 m) with the estimated 100 year migration distance (11 m) (i.e., average rate of channel migration based on the historical air photo record – refer to Section 3.3).

3.3 100-Year Erosion Limit

In accordance with TRCA protocols, the 100-year erosion limit for the unnamed tributary (UT-01) was assessed based on the average rate of channel migration at the relevant study reach. In general, the estimates considered the available photos and images from 1974 and 2015, given that the channel was most visible in these photos/images.

The 100-year erosion limit at the reach length of the UT-01 was assessed based on the average rate of channel migration at the following meander bends (refer to Figure 3):

- Meander Bend #1 (located 230 m downstream from the crossing) – average migration rate of 10 cm/yr.
- Meander Bend #2 (located 300 m downstream from the crossing) – average migration rate of 15 cm/yr.
- Meander Bend #3 (located 330 m downstream from the crossing) – average migration rate of 7 cm/yr.

Based on the historical analysis, the 100-year erosion limit was estimated to be approximately 37 m. This 100-year erosion limit was determined by extending the average rate of migration at the most active meander bend over a 100-year time span (0.15 m/yr * 100 = 15 m), and then applying this distance to either side of the average width of the bankfull channel (15 m * 2 + 7 m = 37 m).

4.0 SUMMARY AND CONCLUSIONS

A fluvial geomorphic assessment was completed at a study reach of an unnamed tributary of the Main Humber River (UT-01) to support a Schedule C Municipal Class EA for the proposed roadway improvements at Coleraine Drive and Harvest Moon Drive. The key findings of the assessment are summarized below:

- The results of the field studies and historical air photo analysis at the reach length of the unnamed tributary (UT-01) suggest that the channel is generally transitional or stressed, noting the following observations:
  - the channel planform is relatively straight (i.e., low sinuosity);
  - the channel geometry is highly entrenched in several sections (i.e., well-incised between steeply sloped banks), while the profile of the channel is relatively flat; and
  - the channel included evidence of aggradation, degradation and widening in a number of locations, noting:
    - examples of sediment deposition features along the bed (e.g., point or side-channel bars on the inside of meander bends, along with medial and lobate bars at some mid-channel locations); and
    - numerous instances of bank erosion/scour along the outside of meander bends (apex or full length of the meander bend), extending vertically from the toe to the top of the bank and resulting in steep and overhanging banks with exposed roots and soil.

- The channel at UT-01 appears to be in adjustment to a new flow and sediment regime. Field observations demonstrate that the stream is actively downcutting and widening (refer to Section 3.1). As a result, the channel is entrenched below the floodplain, meaning that the stream likely conveys flows in excess of the typical bankfull event (before attaining the floodplain) with the potential for short term but notable erosion along bed and banks. These morphologic processes are typical responses to increases in the frequency and magnitude of flows, which may be attributed to the urbanization/development of the upstream catchment area over the last 50 years (and associated increases in impervious area). The construction of the upstream SWM Pond and associated outlet controls (between 1974 and 2015) has likely mitigated the observed erosion-sedimentation processes at the downstream channel to some extent by reducing for example the peak magnitude of flows; however, the channel will likely continue to adjust for the foreseeable future, working to establish a new channel geometry that is in equilibrium with the changes to the new flow and sediment regime brought about by past land use change.
- Based on the desktop analysis, the meander belt width of the reach length at UT-01 is approximately 48 m, while the 100-year erosion limit of the channel is approximately 37 m.

It is understood that roadway improvements at Coleraine Drive may involve upgrades or replacement of the existing crossing structure at the unnamed tributary (i.e., circular concrete culvert with concrete end section, and energy dissipater). According to TRCA protocols, crossing structures should be constructed outside of the meander belt width of a watercourse to the extent possible, or, alternatively, the features should be designed to match or exceed the 100-year erosion limit of the channel. However, for the study reach at the unnamed tributary, it is recognized that spanning a crossing structure the length of the estimated belt width or 100-year erosion limit of the channel would not be practical from an engineering perspective, given that the existing crossing structure (located within the boundaries of the estimated belt width and 100-year erosion limit of the study reach) serves as the outlet control for the upstream SWM Pond (located to the immediate west of Coleraine Drive). Furthermore, Golder is of the opinion that a strategy to match the crossing span to the estimated belt width or 100-year erosion limit is unnecessary from a fluvial geomorphic perspective, recognizing that there is little to no channel morphology to accommodate in the area upstream of the crossing (i.e., the upstream reach has been heavily modified relative to the period of the historical air photo record and is comprised entirely of the SWM Pond and associated inflow and outflow structures). Instead, any proposed modifications to the existing circular concrete culvert should be designed to enhance flow and/or sediment conveyance at UT-01. In addition, the incorporation of bank and bed treatments (e.g., flow dissipation pool, bank revetments, bed armouring, etc.) should be considered at the outlet of the culvert to mitigate any increased opportunity for scour and erosion in the local area or further downstream.

5.0 CLOSURE

We trust that this technical memorandum meets your needs at this time. If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

Justin S. Lim
Junior Water Resources Specialist

Andrew Forbes, MSc, PGeo
Associate, Senior Geoscientist

JL/NP/AF/mp

Attachments:

Figure 1: Site Overview and Field Observed Watercourse Crossing at Coleraine Drive for UT-01
Figure 2: Historical Channel Patterns at Coleraine Drive for UT-01
Figure 3: Estimated Meander Belt Width at Coleraine Drive for UT-01

Attachment A – Photographs
Attachment B – Results of Rapid Geomorphic Assessment
Attachment C – Grain Size Distribution Curves

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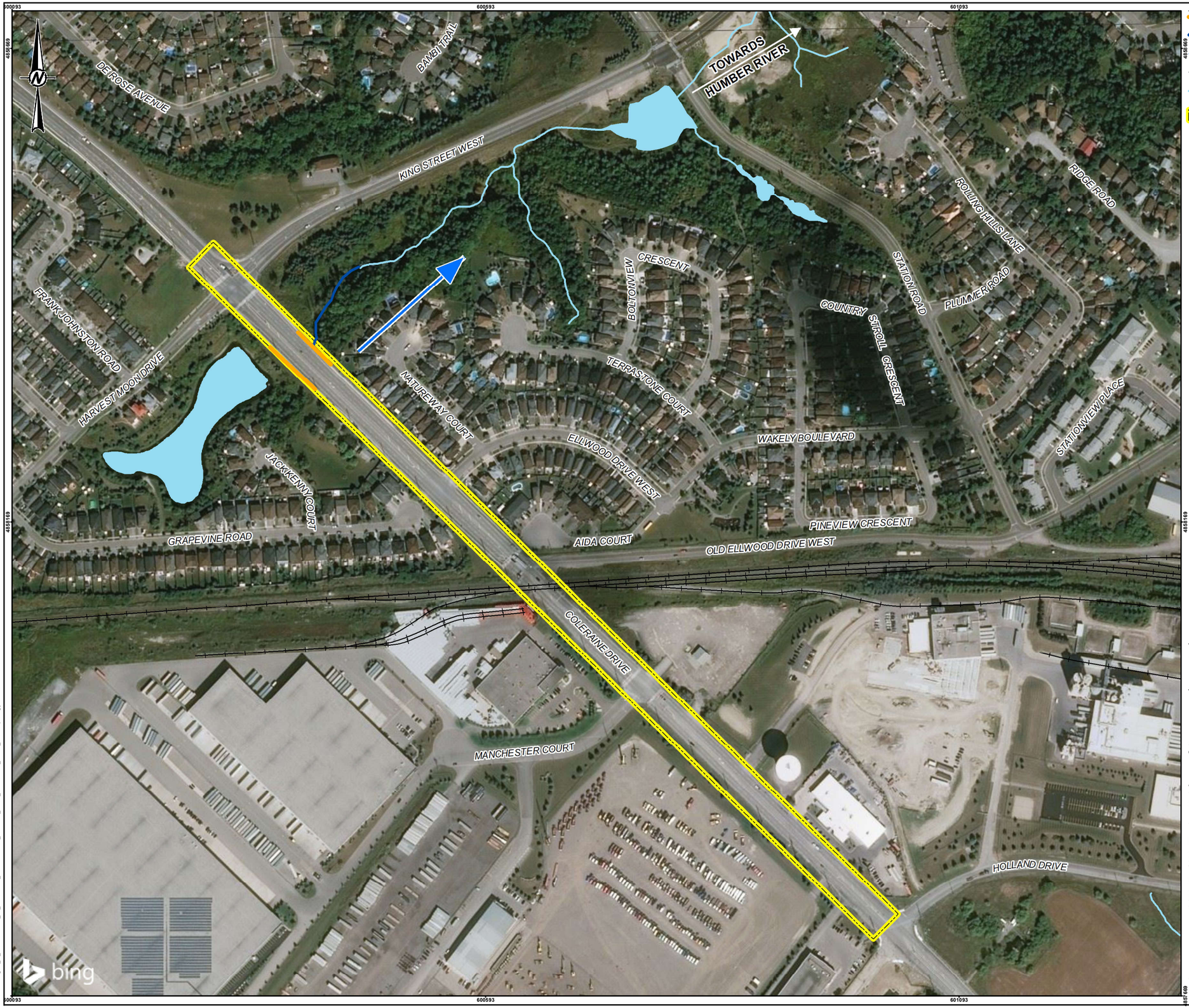
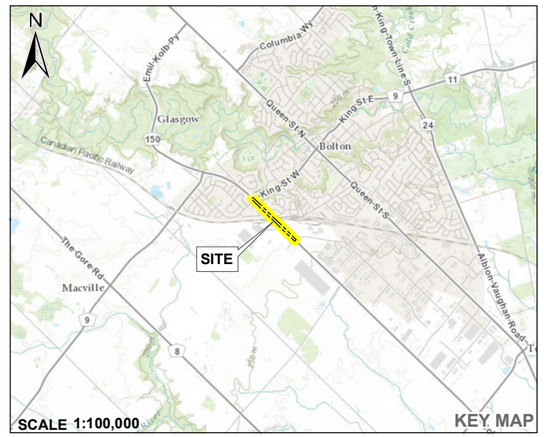
FIGURES



- CULVERT WATERCOURSE CROSSING
- OBSERVED CHANNEL ALIGNMENT (2015)
- FLOW DIRECTION
- RAILWAY
- WATERCOURSE ALIGNMENT PER MNRF MAPPING
- PROJECT LOCATION (COLERAINE DRIVE BETWEEN HARVEST MOON DRIVE AND HOLLAND DRIVE)
- STORMWATER MANAGEMENT PONDS



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NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

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PROJECT
FLUVIAL GEOMORPHOLOGY
COLERAINE DRIVE, CALEDON, ONTARIO

TITLE
SITE OVERVIEW AND FIELD OBSERVED WATERCOURSE CROSSING AT COLERAINE DRIVE FOR UT-01

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-10
DESIGNED	JT
PREPARED	JT
REVIEWED	JL
APPROVED	AF

PROJECT NO. CONTROL REV. FIGURE
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HARVEST MOON DRIVE
COLERAINE DRIVE
NATUREWAY COURT
BOLTON VIEW CRESCENT
TERRASTONE COURT
ELLWOOD DRIVE WEST
JACK KENNY COURT

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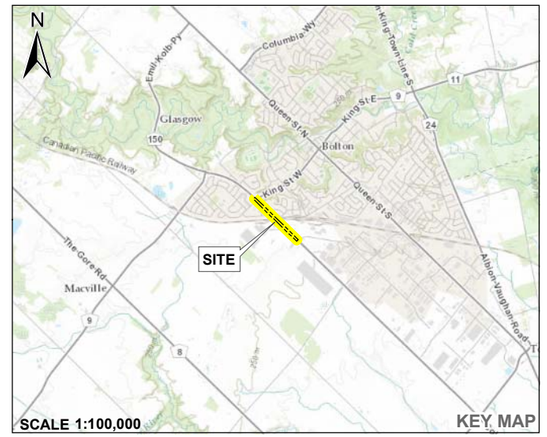
LEGEND

- CULVERT WATERCOURSE CROSSING
- REACH BREAKS
- INFERRED CHANNEL ALIGNMENT (2015)
- OBSERVED CHANNEL ALIGNMENT (2015)
- OBSERVED CHANNEL ALIGNMENT (1974)
- INFERRED CHANNEL ALIGNMENT (1951)
- INFERRED CHANNEL ALIGNMENT (1946)
- 5 M CONTOUR ELEVATION
- WATERCOURSE ALIGNMENT PER MNRF MAPPING
- STORMWATER MANAGEMENT PONDS



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PROJECT
FLUVIAL GEOMORPHOLOGY
COLERAINE DRIVE, CALEDON, ONTARIO

TITLE
HISTORICAL CHANNEL PATTERNS AT COLERAINE DRIVE FOR UT-01

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-10
DESIGNED	JT
PREPARED	JT
REVIEWED	JL
APPROVED	AF

PROJECT NO. 1665649 (8000) | CONTROL | REV. | FIGURE **2**

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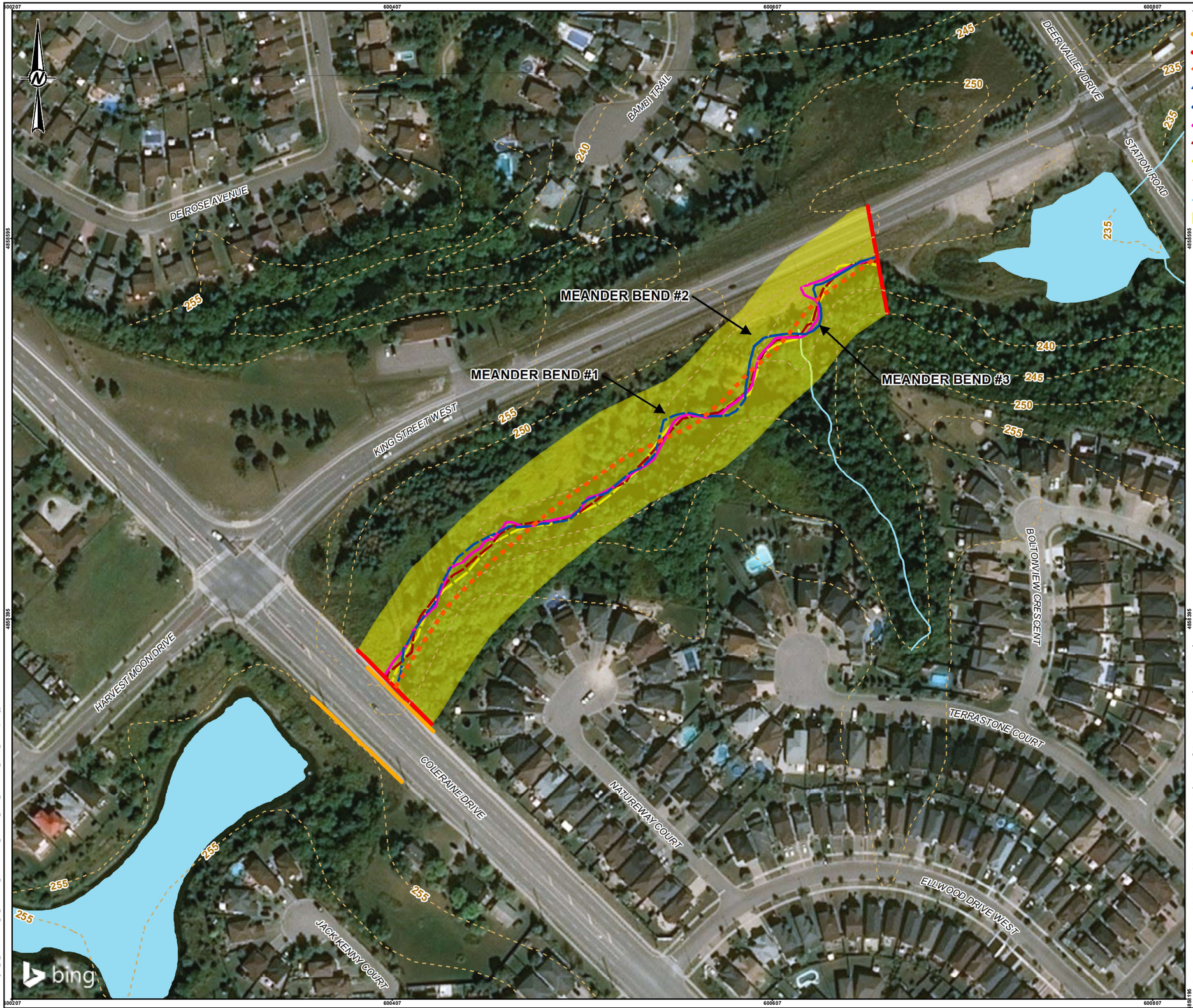
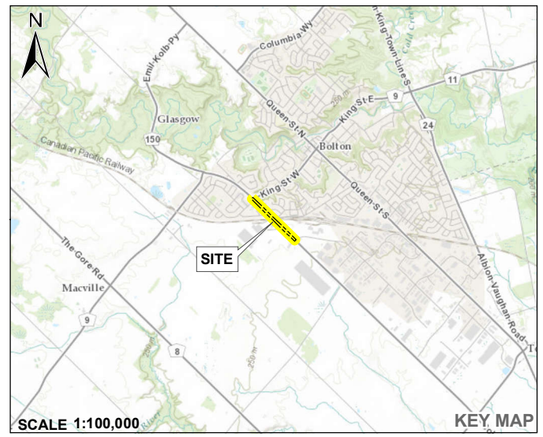


LEGEND

- CULVERT WATERCOURSE CROSSING
- REACH BREAKS
- MEANDER AXIS
- INFERRED CHANNEL ALIGNMENT (2015)
- OBSERVED CHANNEL ALIGNMENT (2015)
- OBSERVED CHANNEL ALIGNMENT (1974)
- INFERRED CHANNEL ALIGNMENT (1951)
- INFERRED CHANNEL ALIGNMENT (1946)
- 5 M CONTOUR ELEVATION
- WATERCOURSE ALIGNMENT PER MNRF MAPPING
- MEANDER BELT WIDTH
- STORMWATER MANAGEMENT PONDS



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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

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PROJECT
FLUVIAL GEOMORPHOLOGY
COLERAINE DRIVE, CALEDON, ONTARIO

TITLE
ESTIMATED MEANDER BELT WIDTH AT COLERAINE DRIVE FOR UT-01

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-10
DESIGNED	JT
PREPARED	JT
REVIEWED	JL
APPROVED	AF

PROJECT NO. CONTROL REV. FIGURE
1665649 (8000) **3**

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ATTACHMENT A

Photographs

Photograph 1: Upstream SWM Pond (located immediately west of Coleraine Drive); looking upstream from road crossing on August 10, 2017.

Photograph 2: Outlet of crossing structure at Coleraine Drive; looking upstream on August 10, 2017.

Photograph 3: Outlet of crossing structure at Coleraine Drive; looking at left bank on August 10, 2017

Photograph 4: Unnamed Tributary immediately downstream of crossing structure; looking downstream on August 10, 2017.

Photograph 5: Unnamed Tributary 25 m downstream of crossing structure; looking upstream on August 10, 2017.

Photograph 6: Unnamed Tributary 75 m downstream of crossing structure; looking downstream on August 10, 2017.

ATTACHMENT B

Results of Rapid Geomorphic Assessment

RAPID GEOMORPHIC ASSESSMENT (RGA)

Date: 10-Aug-17 Location: Unnamed Tributary

Field Staff: Brian Lingelbach, Colin Johnson Project #: 1665649

FORM/ PROCESS	GEOMORPHIC INDICATOR #	DESCRIPTION	PRESENT (YES) OR ABSENT (NO)	
Evidence of Aggradation (AI)	1	Lobate bar	Yes	
	2	Coarse material in riffles embedded		No
	3	Siltation in pools		No
	4	Medial bars	Yes	
	5	Accretion on point bars	Yes	
	6	Poor longitudinal sorting of bed materials		No
	7	Deposition in the overbank zone		No
		RATIO OF INDICES [(1)]	3/7=0.42	
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	N/A	
	2	Exposed sanitary/storm sewer/pipeline/etc.	Yes	
	3	Elevated storm sewer outfall(s)	Yes	
	4	Undermined gabion baskets/concrete aprons/etc.	N/A	
	5	Scour pools d/s of culverts/stormsewer outlets		No
	6	Cut face on bar forms	Yes	
	7	Head cutting due to knick point migration		No
	8	Terrace cut through older bar material		No
	9	Suspended armor layer visible in bank	Yes	
	10	Channel worn into undisturbed overburden/bedrock	Yes	
		RATIO OF INDICES [(1)]	5/10=0.5	
Evidence of Widening (WI)	1	Fallen/leaning trees/fence posts/etc.	Yes	
	2	Occurrence of large organic debris	Yes	
	3	Exposed tree roots	Yes	
	4	Basal scour on inside meander bends		No
	5	Basal scour on both sides of channel through riffle		No
	6	Gabion baskets/concrete walls/etc. out flanked	N/A	
	7	Length of basal scour > 50% through subject reach		No
	8	Exposed length of previously buried pipe/cable/etc.	N/A	
	9	Fracture lines along top of bank	Yes	
	10	Exposed building foundation	N/A	
		RATIO OF INDICES [(1)]	4/10=0.4	
Evidence of Planimetric Form Adjustment (PI)	1	Formation of cute(s)		No
	2	Single thread channel to multiple channel		No
	3	Evolution of pool-riffle form to low bed relief form		No
	4	Cutoff channel(s)		No
	5	Formation of island(s)		No
	6	Thalweg alignment out of phase meander form	Yes	
	7	Bar forms poorly formed/reworked/removed		No
		RATIO OF INDICES [(1)]	1/7=0.14	
STABILITY INDEX (SI) = (AI + DI + WI + PI) / 4 [(2)]			0.36 Transitional	

Notes:

[1] Ratio of Indices or Factor = Number of Indices Present / Total Number of Indices.

[2] Stability Index or SI values inferred as follows: 0.20 or lower = In Regime; 0.21 to 0.40 = Transitional or Stressed; and 0.41 or higher = In Adjustment.

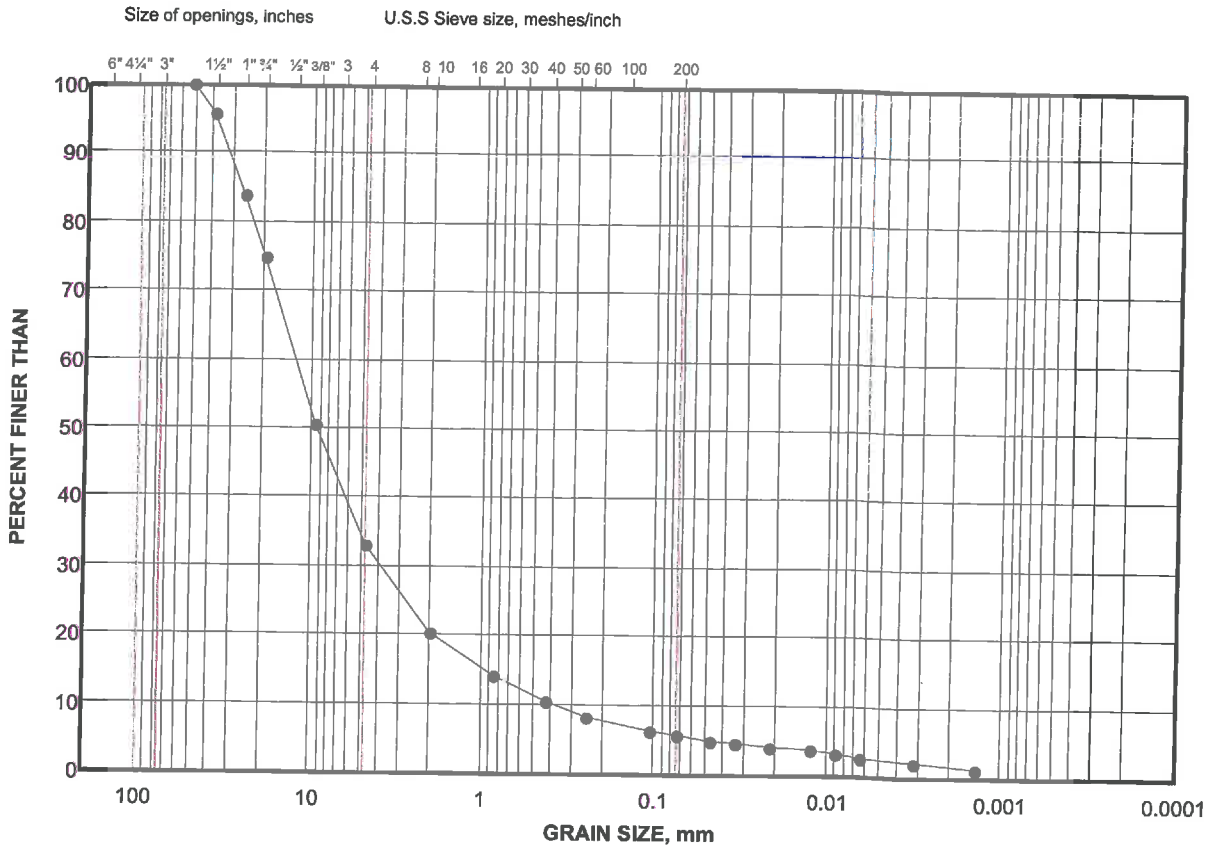
Sourced and adapted from: *Ontario Ministry of the Enviroment, 2003. Stormwater Management Planning and Design Manual.*

ATTACHMENT C

Grain Size Distribution Curves

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	SAMPLE
●	CD01A

Project Number: 1665649

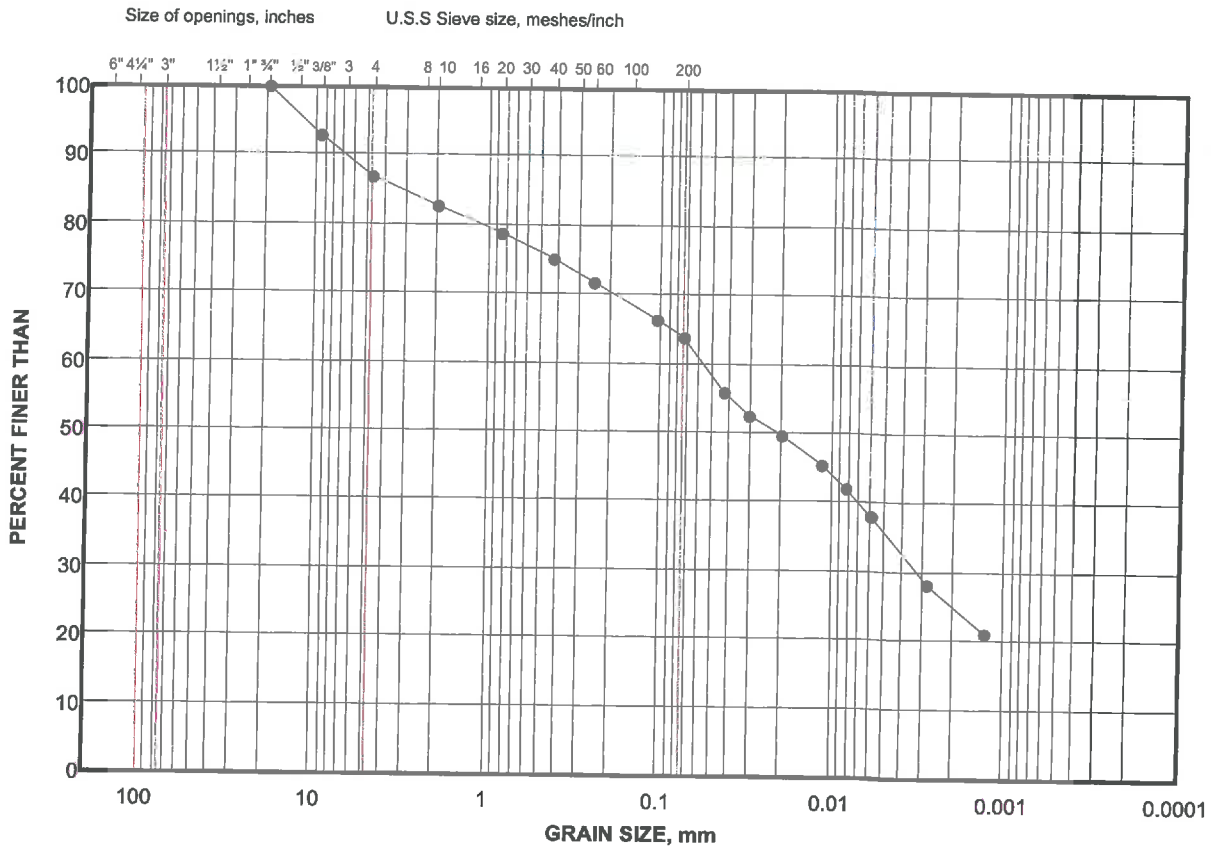
Checked By: _____

Golder Associates

Date: 16-Aug-17

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	SAMPLE
●	CD01B

Project Number: 1665649

Checked By: _____

Golder Associates

Date: 16-Aug-17